GAS JOURNAL, MARCH 19, 1941

VOL. 233 93rd YEAR No. 4061

EDITORIAL NOTES

STANDBY PLANT

WE have recently discussed in these columns the idea of suggesting, in present wartime circumstances, as a standby to town gas, alternative heating agents—among them producer gas and even oil—to cope with temporary interruptions in ordinary gas supply. We have expressed the opinion that the Gas Industry would have everything to gain in national service and its own goodwill by helping as far as possible—with its special knowledge of fuel utilization, both gaseous and solid fuel—to ensure that the consumer receives a continuous heat service. It was with this thought in mind that we inspected a few days ago an interesting form of producer plant manufactured by a well-known firm in the Gas Industry. Simple in construction, this equipment (it is described and illustrated in to-day's "JOURNAL") has the virtue that it needs no skilled labour to operate it, and it is also not costly. It will deal successfully with certain low-temperature cokes, anthracite, and certain high-temperature cokes. It may be noted that the last-named fuels also appear last on the list recommended by the makers of the plant, presumably because of the question of availability, which makes us more convinced of the desirability of doing more work on the production of special cokes and particularly of activated cokes giving a minimum of clinker trouble in use. There seems to us to be a wide future field for the application, on a normal economic basis, of activated high-temperature cokes.

At the moment, however, we are thinking of the maintenance of gaseous heat supply under conditions the reverse of normal, and when the competitive economic aspect has temporarily little or no meaning. With a town gas supply of low pressure much can be done by adjustment of appliances or, in extreme cases, by the judicious installation of fans or boosters. Until quite recently the general impression was that it was essential for industrial appliances and furnaces supplied by town gas to have a pressure of 2½ in. to 3 in. water gauge. It has been found, however, that a pressure as low as 5 tenths water gauge can be employed in a host of industrial processes. Naturally the appliances must be adjusted for such low pressure. In the event of failure of supply recourse should be had to standby plant, and in this regard it will we think be generally admitted that producer gas is a most amenable fuel, very easy to control at the burner. Most industrial town gas equipment, as we have said, can be adjusted to operate successfully at 5 tenths water gauge. If this is done, and producer gas is supplied to the apparatus at, say, 10 in. water gauge pressure, no modification of the burner equipment is required. In many cases it is possible to burn the equivalent heat input of producer gas on a town gas burner without modification by increasing the burner pressure; and where modification for producer gas operation is difficult, the composition of the gas can be changed by the cracking of paraffin in the generator.

The output of the particular unit we illustrate is 2 to 2½ therms per hour, and the units can be installed on the battery system, which obviously provides a very flexible arrangement. The unit which we saw in operation—and it worked very smoothly indeed—has a capacity of 5 therms an hour, and we think there should be a wide sphere of use for units of this size also. We give prominence to the plant as demonstrating once again the Gas Industry's determination to carry on in any and every circumstance, and its ability to cope with the strangest of conditions.

TAR FOR CARBURETTING

WE publish in our issue to-day a brief Paper presented by Mr. L. E. Dequine to the New England Gas Association on the use of tar in a water gas generator, in which the Author gave interesting data on the cycle employed before and during tar operation. Using tar (not dehydrated) the principal change made was to decrease the blow period and increase the amount of air for purging. The experiments he carried out showed that no difficulty is likely to arise in using in the water gas generator all the tar left over after the needed amount has been employed for steam raising, and the conclusion is drawn that there is "nothing to worry about" if all the tar made cannot be disposed of to outside contractors.

It may be recalled that the manufacture of gas from tar was the subject of an article in our columns a short while ago (Nov. 13 of last year) by Mr. G. M. Gill, who dealt with a type of plant, originating in America, similar in several respects to water gas plant. The making of gas from tar is intermittent, as is the making of gas from coke in a water gas plant, a period of blow being followed by a period of run. The plant has worked on continuous vertical retort tar for some time, and the conditions were such that it had every opportunity to show what it could accomplish. It has been used as a peak load plant to make the gas which would otherwise have had to be made by vertical retorts operated at low output. As for the gas produced from the tar, its composition is close to that of ordinary coal gas, with, however, a decreased content of saturated hydrocarbons.

THE RAILWAY CASE

IT may well be that progress is to be speeded-up, and that innumerable things are to be improved beyond all recognition, after the war; but, however great the speeding-up, and however vast the improvement, few will be found venturesome enough to predict the early arrival of the day when the whole of the country's goods and passengers will be transported

from place to place by air. In other words, a long-remaining lease of life may be confidently assumed for our railways, in which to maintain their present vital share in supporting the life of the people. Something of what this share represents is known to all, while much of its value is known to many ; those who know little would do well to know more, and those who know more may well be reminded at a period like the present of what they owe to the vast transport system which has been placed at their service by private enterprise and private capital.

This being so, it is a satisfaction to find that opportunity has been taken of the annual stockholders' meetings of the four great British Railways to place their case fully before the proprietors, and, beyond them, before the public—the Press reports of the proceedings at the four meetings extending to round about twenty columns divided over two recent issues of *The Times*. As must be the case with other public services, the Railways have been working under very heavy difficulties, but they have put forth a splendid effort. They have not done this—they could not hope to do it—without delays and certain other inconveniences to the myriads of people who unavoidably depend upon them for getting to and from their daily work. This full statement of their case, however, will assuredly result in a "toning-down" of the criticism on the part of the public to which reference was made in the course of the proceedings at one or two of the meetings, so far as that criticism might relate to matters beyond the control of the Railway Companies. Thus, solid good should come from putting forward the case in the way that has been done.

The statements made by the several Chairmen show that the Companies have a great case to submit to the tribunal of public opinion—so great, indeed, that there may be just a chance of its very greatness obscuring some of those little points, the very minuteness of which seems in some way to have the power of bestowing upon them a tendency to "get under the skin" of the too often worn and weary traveller. Most of these small points will in all probability be deprived of their sting, if the case for the Companies is not allowed to recede too far into the shade of the public memory, which is usually markedly short. If a certain amount of inconvenience is inseparable from such times as those through which we are passing, this will be more cheerfully borne with constant remembrance of the magnificent work that the Railways are constantly performing in the great fight that is upon us. When inclined to grumble, consider "the case for the Railways" as presented at the recent meetings.

Reports of Company Meetings

Readers will be missing—at any rate for the time being—our customary reports of the annual meetings of gas companies. The powers that be have arrived at the conclusion that publication of such reports is not at the moment in the interests of national security. In the House of Commons last Thursday the Minister of Information said that the Government had the matter under most careful consideration and that a decision on the question would be taken in the near future. In the meantime he asked that the chairmen and directors of public utility undertakings should postpone the publication of accounts and the holding of meetings. It is difficult for us to understand the need to postpone the publication of accounts and the holding of meetings so long as no information is given which would be against the public interest, though naturally we comply with the Censor's request. We hope that the question will be cleared up speedily.

A Good Effort

We congratulate the Scottish Junior Gas Association on the efforts they have made, and with such success, to carry on "business as usual" in spite of war conditions and worries. In January of this year we published a Paper by Mr. K. Sheard to the Western District. It was a most valuable contribution on the highly important subject of benzole recovery in wartime, and it gave rise to a good discussion at, in the circumstances, a well-attended meeting—held, by the way, on a Saturday afternoon. We now are informed of another meeting planned for Saturday, March 29, when the speaker will be Mr. F. Hunt, H.M. Superintending Inspector of Factories. His Address will be on the application of the Factories Act to gas undertakings. We consider the Association fortunate in being able to arrange such an excellent programme. Once again the subject is a most important one, and once again the Association's efforts ought to result in a well-attended meeting.

Personal

We learn that Mr. G. M. GILL, whose address is the Gas-Works, Cheltenham, and who has for some time past been Director and Chief Engineer of the Severn Valley Gas Corporation, Ltd., and Gas Consolidation, Ltd., has now been appointed Managing Director and Chief Engineer.

* * *

A presentation was recently made by Mr. H. Curtis, Engineer and Manager of the Macclesfield Gas Department, to Mr. E. ROWBOTHAM, Works Foreman, on his retirement after 52 years' continuous service in the Gas Department.

* * *

Mr. N. R. REES, who has for some years acted as Technical Adviser to the Foundries Department of the Staveley Coal & Iron Co., Ltd., has been appointed Foundries General Manager in place of the late Mr. J. B. Allan.

Letter to the Editor

Converting Unaccounted-for Gas to Revenue Account

SIR,—The Paper entitled "Co-ordination of Low and High Pressure Supplies," by J. B. Walsh, in your issue of Feb. 9, brings out as never before the importance of constancy of gas pressure in the overall efficiency of modern gas-using appliances.

The Author says: "Consumers' meters are tested to 2 in. pressure. Modern conditions call for a pressure greatly in excess of this figure, and the average pressure of at least 5 in. for the major portion of the day may safely be assumed. Where this great disparity of pressure is entailed an appreciable difference in the volume of gas charged and the volume of gas passing may prove to be a considerable item where several thousand meters are concerned." Therefore I ask, why should not every domestic meter have the governor at the inlet, instead of elsewhere, and thus reduce unaccounted for gas, to "the advantage of revenue ?"

Years ago the practice grew of placing any governor somewhere beyond the meter, so as to fall in the consumer's province of responsibility, but, in these modern days of gas-works' maintenance schemes, and the selling of service, this old custom should give way to the march of progress.

Is it possible that some enterprising meter manufacturer has already on the market a meter with an inlet governor incorporated as an economic component part of the meter's construction, and thus the more economically reduce unaccounted-for gas to the advantage of revenue ?

"AD REM."

March 14, 1941.

National Gas Council

Meeting of Central Executive Board

A Meeting of the Central Executive Board of the National Gas Council was held at Gas Industry House, No. 1, Grosvenor Place, London, S.W. 1, on Tuesday, March 11, under the Chairmanship of Sir David Milne-Watson, Bart., LL.D., D.L.

Coal.—It was stated that a report had been circulated to the members of the Board, which included Mr. Grenfell's statement in the Debate in the House of Commons on Feb. 19 with regard to transport, deliveries, and price of coal. The report also referred to a satisfactory meeting between representatives of the Conjoint Conference of Public Utility Associations and representatives of the Midland (Amalgamated) District and other Coal-Selling Schemes on March 7 regarding the Standard Conditions of Sale.

The position with regard to coal stocks was reported to be still deteriorating in certain districts, and it was stated that complaints with regard to inferiority in the quality of deliveries were becoming more numerous, and that urgent representations in this regard were being made to the Mines Department.

War Damage Bill.—The position in regard to this Bill was reported and it was stated that the Conjoint Conference of Public Utility Associations had been promised that they would be consulted with regard to the new legislation prior to the introduction of the Bill in the House of Commons.

Tracing Addresses of Customers.—It was stated that a suggestion that it should be made compulsory for everyone bombed out of his house or premises to register his new address with the Post Office had the approval of the Conjoint Conference of Public Utility Associations, and that appropriate steps would be taken to submit the proposal to the Postal Authorities.

Other matters dealt with included: (1) The use of gas in communal feeding centres, (2) the use of creosote pitch mixtures for fuel purposes, and (3) the arrangements made by the Council for assisting gas undertakings on rating matters.

In view of wartime conditions, it was agreed to follow the course adopted last year and to issue an Annual Report, but to postpone the General Meeting until conditions were more suitable.

It was agreed that the next meeting of the Board should take place on Tuesday, April 8, at 12.30 p.m.

Drakes, Ltd.

The Directors of Drakes, Ltd., Halifax, report a net profit for 1940 of £10,053. Payment of arrears of preference dividend for the four years 1935–1938 absorbs £9,600, and £1,000 is to be provided for estimated liability under the War Damage Bill. The carry-forward is £16,007, which is £547 less than the balance brought in.

Cambridge Gas Fitter's Bravery

A gasfitter's apprentice, Alfred Ernest Greenwood, employed by the Cambridge University and Town Gas Light Company, has been awarded the Testimonial for Gallantry of the Royal Humane Society. The presentation was made by the Mayor of Cambridge, Ald. E. O. Brown, J.P., in recognition of Greenwood's prompt action when a cyclist accidentally rode into the river on a foggy night during December. In company with two others who arrived on the scene, he dived in and brought the man to safety.

George Medal for Gas Engineer

Official recognition of outstanding gallantry and leadership on the occasion of an air raid is contained in the *London Gazette*.

Mr. John Edgar Stanier, Deputy Gas Engineer to the City of Stoke-on-Trent, has been awarded the George Medal for outstanding gallantry and leadership. Mr. Stanier directed fire fighting, remaining with his men on the crowns of holders while enemy aircraft were overhead, in spite of burns he had received on one of his arms.

Mr. Stanier, who was formerly with the Stockport Gas Department for 15 years, has been Deputy Engineer to the Stoke-on-Trent Gas Department for over seven years. His earlier years were spent with Messrs. Walter Scott & Co., Ltd., of Trimdon, Durham; where he was Chief Chemist and Assistant Manager of their by-product and coke oven plant.

Associated with Mr. Stanier's gallant exploit is Mr. John Simpson Warrilow, Engineering Assistant, who has been awarded the British Empire Medal. Throughout the incident Mr. Warrilow ably assisted Mr. Stanier and displayed great personal courage and resource in carrying out the instructions given to him. He has been with the Stoke-on-Trent Gas Department for ten years.

For their brave conduct in assisting to put out the fires under Mr. Stanier's direction, Mr. Arthur Buckley, works fitter, and Mr. Percy Kelsall, labourer, have been awarded an expression of Commendation for their services in Civil Defence.

Stockton's Kitchen Front Week

Gas Department's Co-operation.

In conjunction with the Ministry of Food, a Kitchen Front Week was held at Stockton-on-Tees from Feb. 22 to March 1. Lectures, food films, the film "A Garden Goes to War," and cookery demonstrations were given in various schools and halls throughout the Borough, and judging by the attendances were much appreciated by the public. The Stockton Corporation Gas Department (Mr. F. L. Scaife, Engineer and Manager) was approached to help; this assistance was readily given, taking the form of fixing high-grade cookers and other gas appliances in any of the lecture halls where a cookery demonstration was required. The Gas Department also fitted up one "Food Shop" with gas appliances, 185 people attending the demonstrations throughout the week.

At the Gas Showrooms, cookery demonstrations were arranged for five days and the food films for one day. The proceedings were opened by the Mayor of Stockton (Alderman J. W. Gargett), who was accompanied by the Town Clerk (Mr. Eric Bellingham), the Gas Engineer, and other members of the Corporation. The Mayor spoke of the contribution the housewives could make to our war effort by getting the best out of home produce. The Town Clerk emphasized how the housewives' shopping helped out shipping. Mr. Scaife hoped that the Stockton public would take advantage of the expert advice to housewives which would be available during the week at the Gas Showrooms.

The cookery demonstrator was Mrs. A. M. Piggott, M.C.A., of London; the demonstrations were well received and attended by over 300 people.

The week coincided with the arrival of a consignment of gas pokers, and no fewer than 300 were sold at the Gas Showrooms during the week. After years of gas poker campaigning at Stockton, the wartime demand is greater than ever.

Vertical Retorts

The construction of vertical retorts is the subject of a patent (No. 533,240; application date, Oct. 20, 1939) granted to West's Gas Improvement Company, Ltd., Sir Frederick J. West and E. West. It is concerned with the building-up of the retorts from bricks or blocks which key into or inter-engage with one another to resist fracture of the setting due to internal pressure or other cause.

The invention comprises forming the bricks or blocks, which when assembled constitute the retort, with grooves at one side and ribs at the other, the grooves or ribs in any side running at right angles to one another—that is, in part parallel to the contour of the retort and in part at right angles thereto—none of the grooves or ribs extending to the working face of the retort, so that the face has plain or straight joints only exposed to the charge within.

The invention further comprises providing the bricks or blocks in each row at opposite sides of the retort with a groove at one side and a rib at the other which extend longitudinally from end to end of the bricks or blocks parallel to the contour of the retort, there being shorter grooves and ribs in and on such bricks or blocks which extend from the longitudinal grooves and ribs only to the outside of the retort and not to the working face.

The bricks or blocks in each row at each end of the retort are provided with a groove at one side and a rib at the other which extend from end to end of the bricks at right angles to the major axis of the retort, shorter grooves and ribs extending from the groove and rib respectively to join with the longitudinal groove and rib in the corresponding side row of the bricks or blocks and to extend to the outside of the retort parallel with the major axis of the latter.

Removal of Sulphur Compounds from Gases

A patent (No. 533,009; application date, June 29, 1939) taken out by the Gas Light & Coke Company, R. H. Griffith and B. Crawley, relates to the removal of organic sulphur compounds, such as carbon disulphide and carbon oxysulphide from gases, such as water gas and gases used for the synthesis of hydrocarbons from carbon monoxide, which are substantially free from hydrocarbons of the type which are strongly adsorbed by activated charcoal—*e.g.*, from hydrocarbons which are liquids at ordinary temperatures.

According to the invention there is provided a process for the removal of organic sulphur compounds from a gas which is substantially free from hydrocarbons strongly adsorbed by activated charcoal, which process includes the step of bringing the gas at an elevated temperature into contact with a catalyst comprising the sub-sulphide of nickel or cobalt supported on an activated charcoal carrier. The gas is preferably brought into contact with the catalyst at a temperature between 150° and 250°C. and the hydrogen sulphide formed from the organic sulphur compounds may be removed from the gas—*e.g.*, by means of iron oxide.

A catalyst mass for use in the above-mentioned process may be prepared by a process which includes the step of immersing activated charcoal of the type used for the recovery of benzole from coal gas in a solution of a sulphur compound of nickel or of cobalt reducible to sub-sulphide and subsequently drying the charcoal and reducing the sulphur compound to sub-sulphide by heating in hydrogen or in a gas containing hydrogen or carbon monoxide at 350° to 400°C. for at least two hours.

The sulphur compound of nickel or of cobalt may consist of the sulphates of these metals and a mixture of the sulphate of cobalt with the sulphate of nickel may also be used. Instead of the sulphate, double salts such as cobalt ammonium sulphate, or sulphites, thiosulphate, sulphamates, and other sulphur-containing salts which can be reduced to sulphides may be employed.

The solution of nickel or cobalt compound may be maintained at elevated temperature—*e.g.*, at boiling point during the treatment of the charcoal therewith. Alternatively, a cold solution of the nickel or cobalt compound may be applied to charcoal from which all gases have been removed—*e.g.*, by means of a vacuum pump. The concentration of the solution, which is preferably an aqueous solution, may be such that about 10% or less of nickel or cobalt remains in the finished catalyst after draining and drying. The charcoal used should preferably have a low retentivity.

A catalyst mass prepared as above will treat several thousand volumes of water gas at 200° to 250°C. per hour per unit volume of catalyst space. A lower temperature may be used but in that case a larger amount of catalyst would be necessary to treat the same volume of gas. Following is a description by way of example of one method of carrying the invention into effect.

Example.

250 lb. of charcoal pellets of the type used in the recovery of benzole from coal gas approximately ⅛ in. in diameter, and ¼ to ½ in. long, occupying a space of 10 cu.ft., is plunged into a boiling solution of nickel sulphate of such strength that 100 lb. of the liquid contains 12½ lb. of nickel. After a few minutes the pellets are removed from the solution, freed from excess liquid and dried. The catalyst is activated by treatment with hydrogen or with a gas containing free hydrogen or carbon monoxide, at 350°–400° C. for two hours.

The catalyst is then used to treat water-gas which has been purified from hydrogen sulphide but which still has a total sulphur content of 8–10 grains per 100 cu.ft. 20,000 cu.ft. per hour of gas are passed at 200° to 210°C. over the catalyst, and the treated gas is then purified by known methods for the removal of hydrogen sulphide or of sulphur dioxide. In the final gas the total sulphur content is so low that very special methods have to be applied for its accurate determination.

(*Further abstracts of new patents will be found on p. 514*)

FURNACE DESIGN

[Contributed]

WHEN considering the installation of any type of furnace the user has one primary thought in mind—the heating of some material or other to a certain temperature in the most effective manner. The fuel to be employed is a secondary consideration, with a natural bias towards that which costs less money, or that which is already in use on the works.

Irrespective of whether required for a low temperature—say, 500°F.—or a temperature of 1,600°C. the furnace must be capable of attaining that temperature in the shortest permissible time; the temperature throughout the working chamber must be uniform or graded as required; and the furnace must be adaptable to efficient automatic control. Taking these points in this order it will be agreed that all known fuels, other than liquid ones, may be effectively utilized at the lower temperatures, and all fuels are potential competitors at higher temperatures, although certain ones are apt to be expensive when so used.

Uniformity of temperature rules out the solid fuels since variation in heat output must occur with differences in depth of fuel bed and alterations in chimney draught, variations in calorific value, and air temperatures, even when automatic stoking machinery is employed. Controllable atmosphere inside the working chamber can be simply achieved only by gaseous fuel, and, if required to be within very fine limits, only by town gas. Most fuels may be so applied that automatic control of temperature is possible in some degree, but in no other can the refinement be carried to the same degree of accuracy as with town gas.

The fact that a solid fuel fired furnace employs direct heating, is manually controlled, and does not provide any means of recuperation or regeneration, does not mean that the furnace is not effective. It may be even more so than the most carefully designed furnace fired by some other fuel and fitted with every form of automatic control, but it does not follow that the furnace will be efficient thermally. Until recently, town gas has been relatively expensive compared with solid and liquid fuels, especially when examined only from the basis of bare B.Th.U. costs, and although most undertakings have had to increase their charges, the balance is now favourably inclined towards gas.

In former years designers have given their attention towards improvements in furnace structure and materials while neglecting the burners, which, as with all gas-consuming appliances, are one of the fundamental features of every furnace. Excepting furnaces employing surface combustion or radiant tube principles there has been little real progress in burner design during the last decade. Had the same attention been paid to industrial burners as to those used for domestic apparatus we should not have cases where important furnace builders provide nothing better than a short length of barrel suspended above the port from which the secondary air issues.

The manner of supplying the gaseous heat and the type of burner through which the heat is applied depends largely on the temperature required and the process to be carried out. Not every furnace is as economically adaptable as may be thought—a fact which is responsible for many complaints of unsatisfactory results.

Method of Heating

For temperatures not more than 1,000°C. natural draught burners can meet every requirement, and, in certain cases, natural draught burners have been used for furnaces up to a temperature of 1,400°C. When considering the method of heating and size of furnace one must keep in mind that the figure of 1,000°C. applies to open type furnaces where combustion is taking place in the immediate neighbourhood of the work, and will not generally apply in muffle and semi-muffle furnaces where heat has to be transmitted through a protecting wall of refractory material before coming into contact with the work to be heated. Natural draught burners have the advantage of simplicity of regulation, single tap control, and absence of auxilliary plant for pressure raising. Secondary air must be admitted to the combustion chamber to complete combustion of the gases, and some form of limiting this air admission is usually incorporated in the design. Unfortunately, these are often of such a nature that accuracy of control is impracticable and the quantity of air is usually considerably in excess of that required. Where multiple flame burners are used as below the furnace hearth and similar positions, the flame orifices must be raised a sufficient distance above the surrounding metal to permit the secondary air to circulate freely around the flames.

Pressure systems employing either gas or air under pressure are essential for higher temperatures, or when intense local heat is desired. With the latter separate gas and air controls must be provided, and great care is needed to ensure that correct proportions of gas and air are admitted to the burner. Any alteration in temperature or working conditions calls for corresponding alterations in gas and air controls, with the result that inefficient combustion may frequently arise and lower the efficiency of the furnace or cause an undesirable alteration in the furnace atmosphere.

The high pressure gas burner approximates in construction to the low pressure type, being equally simple in control and operation. With a correctly-designed high pressure burner it is possible to entrain sufficient air for complete combustion, but such a burner can be operated only within a very narrow range of consumption without danger of the flame striking back when the quantity of gas is reduced below a certain quantity or pressure. To obtain the best effect the burner should be fitted with some quickly operable device for reducing the area of the air ports should it become necessary to work the burner below the minimum output for which it is designed. In cases where frequent alteration is likely, as instance periods when the furnace is not in full operation yet must be kept at a certain temperature, auxiliary natural draught burners may be fitted for use during these "off" periods and so obviate frequent alteration of main burners.

Pre-mixed gas air and gas-air proportioning systems, employing burners of simple design using a mixture ratio from 1–1½ up to 100%, are becoming increasingly general for installations with a large and fairly constant load. Although more expensive in capital costs than other pressure systems, pre-mixing can be made to give more efficient combustion while retaining the simplicity of control associated with natural draught.

Essential features of every burner are even distribution of heat over and around the area of furnace surface or material requiring heat; to carry combustion to the stage desired (*i.e.*, complete combustion of the gas if necessary); uniformity of performance within the limits of minimum and maximum output; ease of control. The majority of town gas fired furnaces are fitted with burners employing one of the previously mentioned systems of gas and air admixture prior to ignition, and therefore the burners have a point below which the gas consumption cannot be reduced without the flame speed becoming higher than the velocity of the gas and causing the flame to strike back.

With burners designed to entrain a supply of primary air the size, shape, and position of the gas orifice becomes extremely important. The actual length of the orifice should not exceed the diameter, must be drilled with absolute accuracy and free from obstruction, and should, on the supply side, be tapered to form a definite lead for the gas stream in order to reduce to a minimum the resistance to flow. Retention of maximum velocity of gas flow, coupled with correct proportioning of the throat of the venturi, gives maximum primary air entrainment and more intimate mixing of gas and air. The heat input of a burner is dependent upon the area of the port or ports from which the mixture issues into the combustion space. Size of gas orifice, area of primary air inlets, diameter of venturi, and outlet area of burner head must be correlated and correctly proportioned in order to produce an efficient burner, and applies in all cases other than those using 100% mixture.

The latter type is usually employed in some form of surface combustion with the gas burning in or on a bed of refractory material, in a refractory lined tunnel, or on the surface of a granular refractory block. Extremely high heating capacity can be obtained with this type of burner, but the application is not so wide as with natural draught or the ordinary pressure type.

Radiant Tube Heating

The radiant tube method of heat transference represents the greatest advance in burner design of recent years. Although the scope is limited by the heat-resisting qualities of the tubes in which the gas is burned, the principle is one which can be adapted to many heating operations, with the great advantage that products of combustion cannot enter the furnace proper,

and therefore the atmosphere can be kept perfectly clear of any gases or fumes other than those given off by the material undergoing treatment. Since the heat transfer is totally by radiation the disposition of the tubes, and the heat output of each tube, can be arranged to give the most effective result without having to consider the positions of flues or air passages in the hearth and walls. Combustion being carried out progressively along the tubes, and each tube being under separate control, uniformity of temperature can be readily attained, and the principle has been successfully applied for metal melting and heat-treatment in general.

The ideal furnace is, of course, that which has been designed for a definite object and is being used for that one purpose. Unfortunately this is seldom possible, and one is obliged to adapt a standard type to meet requirements, having in mind the user's need for effectiveness in carrying out the work. Many factors need to be considered, particularly the type of flame suited to the work, for upon this depends the actual flame temperature and the rate of heat transfer from the gas into the load. Maximum flame temperature is attained only when the exact amount of air to complete combustion is admitted to the combustion space. Such a result is seldom achieved, although nothing can be lost in making the attempt and ensuring that air slides and regulators can be adjusted to the most minute degree. Excess air not only has to be heated in its passage through the furnace, but also carries away with it heat which prove that his furnace is superior to that of a competitor. In a sphere where thermal efficiencies have generally been on the low side, an increase of 2 to 3%—which is probably the utmost difference between similar furnaces by reputable makers—will often be found to have a negligible effect on the efficacy of the heating operation.

Burner Position

The importance of burner position is shown in fig. 1, a, b, and c. Furnace a is provided with 8 burners, staggered 4 on each side at 10 in. centres. The flames circulate below the crown and down the sides of the furnace, and then pass through ports which lead to a chamber below the hearth and from there to a vertical flue in the back wall and so to atmosphere. Pre-mixed gas and air is used, and the maximum temperature variation between crown, centre, and base is no more than 8°C. Fig. 1, b and c, show another open furnace before and after alterations made with a view to obtaining a more uniform temperature. As originally constructed, two burners were provided, one on each side of the furnace, A being 9 in. from the crown and 8 in. from the front, and B 6 in. from the base and 9 in. from the back wall. This furnace also uses pre-mixed gas and air without recuperation. As will be seen from b, there was a considerable difference in temperature between the base and higher parts of the furnace. The burners were removed

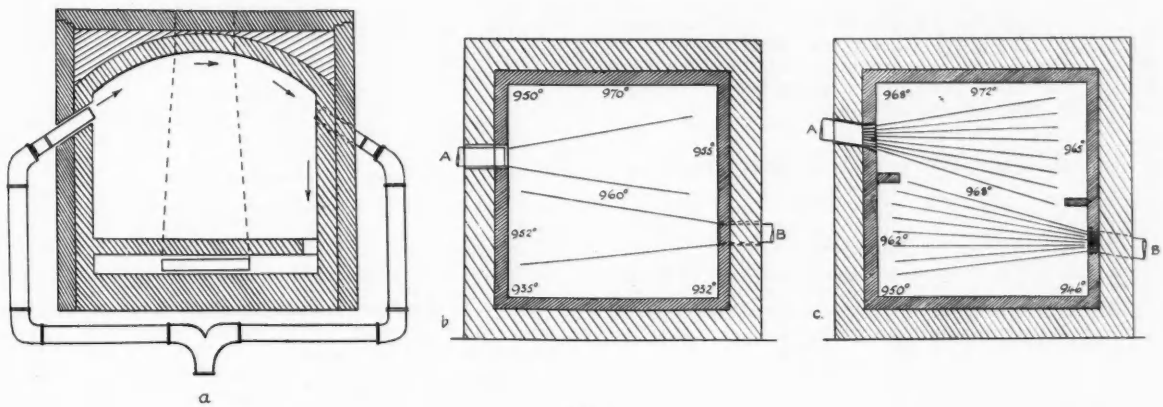


FIG. 1.

should be more usefully employed. The higher the temperature at which the furnace is operated, the greater the effect of heat loss by excess air, with the result that a greater quantity of gas is required to maintain the temperature at a given degree.

	Temperature inside furnace.		
Excess air.	1,350° C.	1,100° C.	1,000° C.
20%	025 cu.ft. per hour	122 cu.ft. per hour	85 cu.ft. per hour
40%	327 " "	14 " "	92 " "
60%	694 " "	168 " "	116 " "

Whereas the true surface combustion principle imparts the heat almost entirely by radiation, the ordinary method of combustion transmits its energy partially by radiation from the flame itself and the refractories raised to incandescence, and partially from radiation and conduction from the hot gases. In certain classes of work it may be advantageous to use a soft luminous flame, highly charged with incandescent particles of carbon, and thereby heat-up the work more quickly than by means of a short hard flame with its more restricted area of effect. In such circumstances combustion cannot be completed without the admission of secondary air—probably in excess of needs—and the difficulty is then to decide whether efficiency should be sacrificed for effectiveness. The thermal efficiency of a furnace may be affected in so many ways that even with the most careful positioning of burners, control of air admission and flue outlets, correct thickness of wall and crown, adequate provision of insulation, &c., the resultant efficiency may be considerably reduced by carelessness in operation, incorrect disposition of the load, and similar factors over which the designer cannot have control. None the less, the furnace may be effective in that the heat transmission to the work may be relatively high, and therefore show a highly effective heating operation from a low thermally-efficient furnace.

This fact may not satisfy the technician who is anxious to and the openings in the walls altered to throw the burners some 5° from the horizontal, A downwards and B upwards, and the positions moved to 5 in. from the crown and base respectively, though the same distances from front and back. In place of the open end heat-resisting nozzles special perforated refractory blocks, drilled at angles from 5° to 17°, were fitted in the end of each burner before cementing the latter in position. A 3½ in. baffle was built along each side of the furnace to break-up the stream of hot gases. The improvement in uniformity of temperature is shown by the figures taken, in each case, from the chart of a recording pyrometer.

(*To be continued*)

Broadstairs U.D.C. have informed the Broadstairs Gas Company that they are not prepared to agree to a remission of 75% of rates due, and have suggested that, pending the result of an appeal for a reduction in rateable value, a payment on account should be made.

It has been Agreed with H.M. Customs that the Purchase Tax of 33⅓% on gas mantles is to be computed on the retail trade price, in the sense that on deliveries under 5 gross it is charged on the 1 gross price, for 5 gross and under 10 gross on the 5 gross price, and for 10 gross and over on the 10 gross price, after deduction of 2½% cash discount, this being applicable to all buyers, irrespective of class of customer. Registered factors and wholesalers are to follow the same practice.

Ekeing Out the Meat Ration with vegetables, rice, suet crust, or oatmeal pastry is one of the devices by means of which the clever cook makes wartime fare attractive. The family meat allowance will be spread more evenly over the week if it appears as meat and vegetable pudding, meat roll, or beef in batter. These and many other delightful recipes for "Making a Little Go a Long Way" are published in a leaflet under this title issued by the Women's Gas Council. Copies of the leaflet can be obtained, price 2d., including postage, from the Acting Secretary of the Council, 1, Grosvenor Place, London, S.W. 1.

THE STEAM LOAD ON SMALL GAS-WORKS

By T. S. RICKETTS, *Tottenham & District Gas Company*

MANY gas-works raise the majority of their steam in waste heat boilers attached to the retort bench. At Hertford the waste heat boiler had to deal with increasing volumes of waste gases as the throughput of the bench progressively increased and in consequence it became somewhat overloaded. Test I (Table I) is of interest as it shows the effect of overloading on the steam yield. A new and larger boiler is under consideration at the present time. Test II shows the probable steam yield that may be expected.

Rear waste gas dampers are provided on the settings whereby the waste gases may be passed directly to the main flue, thus by-passing the recuperator. These rear dampers were originally provided in order to maintain even temperature zoning throughout the retort, but we find it unnecessary to have them opened more than a fraction. In view of the modern tendency wholly or partly to abolish recuperators in favour of waste heat boilers, the results of tests taken with recuperators partly by-passed are of importance. These are set out in Test III. During the test the rear dampers were opened some 4 in., the dampers at the base of recuperators being closed accordingly to maintain a constant temperature in the combustion chamber.

While conditions were not conducive to loading the boiler further, an increase of steam yield was obtained which might prove valuable under peak load conditions.

TABLE I.—TEST FIGURES FOR WASTE HEAT BOILER.

	I.	II.	III.
1. Test			
2. Coal carbonized per day, tons	35	35	35
3. Producer fuel, lb. per hour	465.5	465.5	491.5
4. (3) as percentage of (2)	14.25	14.25	15.05
5. Temp. of gases at boiler inlet, °F.	1,300	1,300	1,420
6. Temp. of gases at boiler outlet, °F.	510	470	520
7. CO_2 content of gases at boiler inlet	16.2	16.2	16.5
8. Steam pressure, lb./sq.in. gauge	100	100	100
9. Superheat, °F.	237	—	267
10. Temp. of feed water, °F.	180	180	180
11. Lb. water evaporated per hour actual	1,100	—	1,325
12. Lb. water evaporated per hour, from/at 212 °F.	1,311	—	1,600
13. Evaporation per lb. fuel, from/at 212 °F.	2.82	—	3.25
14. Calculated evaporation lb. from/at 212 °F.	2.95	3.09 calc.	3.34
15. Steam equivalent of power required by fan	245	163	255
16. (15) as percentage of (12)	18.5	15.0	15.2
17. Blow down loss (continuous system) percentage of (12)	4.7	4.7	4.3
18. Heat in waste gases entering boiler. B.Th.U. per lb. coke	4,590	4,590	4,930
19. Heat in waste gases leaving boiler. B.Th.U. per lb. coke	1,732	1,586	1,733
20. Heat loss while passing through boiler. B.Th.U. per lb. coke	2,758	3,004	3,197
21. (20) as percentage of (18)	62%	65%	65%

It must be remembered, however, that any extra steam gained is obtained by burning a saleable fuel, coke, and in the example quoted, 1 lb. coke produced 11.3 lb. steam. The cost of fuel only for this steam would be approximately 16d. per 1,000 lb. steam (coke at 35/- ton).

TABLE II.—WASTE HEAT BOILER.

Cost per 1,000 *lb. Steam Generated from particulars in Table I.*

	Pence per 1,000 lb.
1. Feed water (from river) pumping cost	—
2. Softening	0.30
3. Repairs and maintenance	1.21
4. Attendance and cleaning	.50
5. Interest and depreciation, 10% capital	(ignored)
6. Fuel (*all* waste heat)	—
	2.01

Solid-Fuel Boilers

The average Cornish or Lancashire boiler is usually rather neglected by technical staffs, and yet it is a simple matter to take routine tests on flue gases and temperature and anemometer readings on the stack. Two of the common losses are due to enlarged steam jets on breeze-burning furnaces, causing a constant waste of steam, and CO in the flue gases caused by too deep a fuel bed. Table III shows results of tests taken on a Cornish boiler.

TABLE III.—TEST ON SOLID FUEL BOILER.

	Fuel.	Breeze.
Plant.		
1. Cornish boiler with superheater	Moist	21.2
	Ash	9.0
	V.M.	11.5
	Fixed C.	58.3
	Calc. C.V.	10,900 B.Th.U. per lb.
Fuel.		
1. Total used, lb.		2,663
2. Average used per hour, lb.		443.8
3. " " per sq.ft. grate area, lb.		35.5
Water.		
4. Total evaporated, lb.		12,516
5. Average evaporated per hour, lb.		2,086
6. Returned *via* blow down (continuous system)		210
Averages.		
7. Steam pressure-gauge, per sq.in.		102
8. Feed water temp., °F.		175
9. Superheater temp., °F.		467
10. Temp. of flue gases at base of stack		700
11. CO_2 percentage		17.4
Results.		
12. Lb. water per lb. fuel as fired		4.7
13. " " from/at 212°F.		5.39
Heat Balance.		
14. Boiler	45	
15. Superheater	3	
16. Plant efficiency		48
Heat Losses.		
17. Chimney losses	19	
18. Radiation blow-down and unaccounted-for	33	
		100%
19. Steam taken by jets for forced draught as percentage of (5)		6.5%

TABLE IV.—CORNISH BOILER.

Cost per 1,000 *lb. Steam Generated.*

	Pence.
1. Feed water (pumping cost)	—
2. Softening	0.30
3. Repairs and maintenance	1.60
4. Labour* (see note).	
5. Fuel 213 lb. breeze at 10/- ton	11.41
6. Interest and depreciation	(ignored)
	13.31

* Included in stokers' duties.

The fuel to producers in Test III is as accurate as could be determined over a period of seven days, but since fuel to horizontal settings is notoriously difficult to measure, it represents a justifiable source of criticism. To summarize, recuperators attached to retort settings must theoretically leave some 40% of heat in the waste gases, and the waste heat boiler will perform valuable service by recovering a large part of this heat. But when increased yields of steam are obtained by reducing the amount of recuperation, the significant fact remains that the extra steam is obtained by burning fuel of a value often three times greater than that which can be burned in a solid fuel boiler. The relative overall efficiencies of the two boilers are not such as to counterbalance this difference, and therefore other factors such as labour costs or increased capital charges must decide the final economies of the two methods of steam production.

Steam Distribution on the Works

It is not usually an easy matter to obtain a knowledge of the relative amounts of steam used on the various portions of plant. A steam meter is very desirable, but where unobtainable much can be done on plants such as benzole recovery, ammonia concentration, and the dri-gas engine where this exhausts into the evaporator, by measuring the condensate obtained.

As far as gas outputs will allow, producer gas dilution is practised at Hertford, the process steam required for its production being small. The steam load is taken mainly by the waste heat boiler, while the Cornish boiler takes the excess. The relative ratios of loads taken by both boilers does not tend to alter appreciably as the output of coal gas increases, since a corresponding increase is observed in the output of waste heat steam.

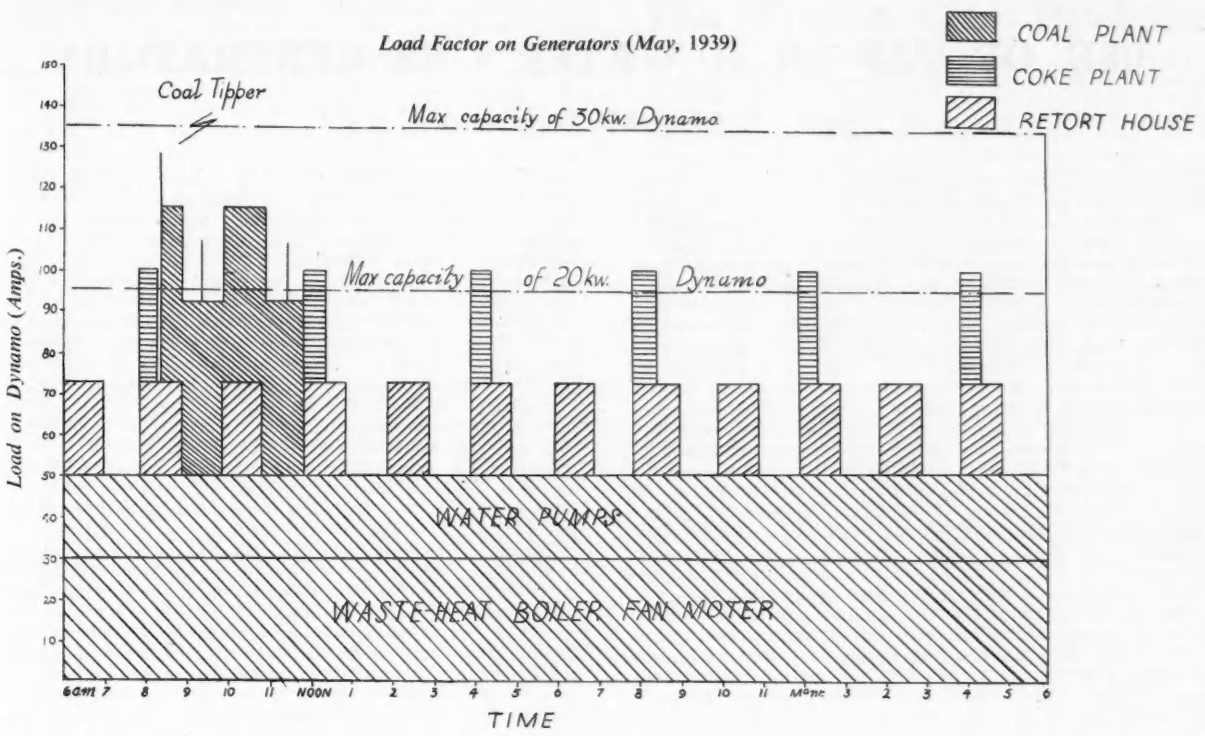


FIG. 1.

Directly the water gas plant is started, however, an extra load is placed on the Cornish boiler, since the plant is not fitted with a waste heat boiler, and an unbalanced effect is obtained.

Considerable use is made of electricity on most works, and Hertford is no exception. There are three steam-driven dynamos of 6 kw., 20 kw., and 30 kw. capacity respectively. For obvious reasons as good a load factor as possible should be placed on the dynamo and the systematic application of various loads is very important.

TABLE V.—STEAM CONSUMPTION OF 30 KW. DYNAMO.

100%	load factor ...	37	lb. per kw.
75%	,, ,, ...	42	,,
50%	,, ,, ...	51	,,
25%	,, ,, ...	81	,,

A good base load is obtained by the load from motors driving water pumps and waste heat boiler fan. The typical daily load curve on the dynamo is shown in fig. 1, the average load factor being about 52%.

LIST OF ELECTRIC MOTORS IN USE.

Description of duty.	H.P.	Revs.	Amps.	Amps. under load.	Rating.	Winding.
Belle Isle	¾	1,420	3·3	2	Cont.	...
C.W.G. Auto	1·5	1,000	6·9	4	½ hour	...
Coke screens	3	750	12·8	6	Cont.	Compd.
Portable conveyor	3	1,000	13	10	Cont.	Shunt.
Charging machine	4	150–1,500	17·6	10–20	½ hour	...
Coke conveyor belt	5	...	21	10	Cont.	Shunt.
Coal tippler	5	750	21	20–30	1 hour	Compd.
Coal chain	5	820	21	17	Cont.	,,
Coal conveyor belt	5	750	21	12	,,	Shunt.
Discharger hoist	6½	...	29	10–20	½ hour	Compd.
Water pumps	6	980	23·6	20	...	...
Hot coke conveyor	6	1,150	24·8	17	Cont.	Compd.
Discharger ram	6½	...	29	5–10	½ hour	,,
Waste heat boiler spare ...	7	1,220–1,470	29	...	Cont.	Shunt.
Machine shop	7	...	...	5	...	...
Coke breaker	7½	1,430	30	12	...	...
Coal elevator	9	720	36·3	20	Cont.	Compd.
Coal breaker	10	750	40	10–20	,,	,,
Waste heat boiler	11	1,355–1,560	44·5	20–40	,,	,,

The water pumps are also arranged for alternative drive by steam; consequently it is an easy matter to reduce the load on the dynamo when necessary.

Benzole Plant

This plant has a steam consumption of approximately 1.1 lb. per gallon oil calculated. The total consumption thus varies between 126 and 252 lb. per ton coal, according to the requirements of benzole recovery and sulphur removal, an average figure being 150 lb. steam per ton coal carbonized. 1 lb. steam per gallon oil is rather high, but is explained by the fact that the plant is not fitted with modern heat exchanges.

TABLE VI.—TOTAL STEAM REQUIREMENTS ON WORKS.

Coal Gas/Producer Gas.

Production.	Lb. steam per ton coal.
Waste heat boiler	907
Cornish boiler	180
	1,087
Distribution.	
Generation of electricity	545
Benzole plant	150
Dri-gas plant engine	120
Exhausters	158
Boosters	120
Remainder, including losses	114
	1,087

As stated before, steam requirements per ton increase considerably when water gas manufacture commences, and Table VII shows the effect of a 30% volume water gas dilution to the coal gas/producer gas stream.

TABLE VII.

Production.	Lb. steam per ton coal.
Waste heat boiler	907
Cornish boiler	920
	1,827

This means that the water gas plant requirements average 100 lb. steam per 1,000 cu.ft. of gas made. The total figure, 1,827 lb. steam per ton of coal carbonized, shows the importance of stating the diluent gases employed when quoting figures for steam per ton of coal carbonized. Similar reasoning applies where high steaming is resorted to on verticals, and no general figure can therefore be given for lb. steam per ton coal carbonized on any particular works until the local conditions are stated.

USE OF TAR IN A WATER GAS GENERATOR*

By L. E. DEQUINE, *Long Branch, N.J.*

FOR several years we had been selling our tar to paving contractors at a fairly good price, but we were required to store the tar during the season when there was no demand for it. As our tar was particularly heavy and the only place to store it in quantity was the relief holder, we had to keep the tar hot in order not to interfere with the operation of the holder. Over a period of time this continuous heating had a tendency to increase the viscosity of the tar beyond the point at which the road makers could advantageously use it. Several times we had trouble in disposing of our stock. Two years ago in order to eliminate this winter accumulation we put in burners to utilize tar in the steam boilers. We found that we could replace other fuels to a value of 3c. per gallon for about 70% of our make. The balance could be used to generate electricity but the value was only 1¼c. per gallon.

A comparison of the B.Th.U. value of the tar with that of the coke which we were using would indicate a value of 5¼c. per gallon on the assumption that tar could be used to replace generator fuel with the same efficiency. Even with some decrease in efficiency tar could still be disposed of more economically by using it in the generator than in any other way.

We were fortunate to obtain a contract for the sale of our tar at a somewhat low but very fair figure for 1940 ; and because of the large accumulation during the winter, we wanted to dispose of all the tar we possibly could before the end of the paving season. Had we used dry tar in the generator, we would necessarily have had to cut shipments, as the contractor was willing to take all that our dehydration plant would handle. We wanted to burn tar in the generator, and we wanted to be sure that what was thus used was in addition to what we could dispose of otherwise. We therefore took the emulsion as it was sent to the stills with about 30 to 50% water, and almost all our experimentation was done with this type of material. We ran for one or two days on dehydrated tar; and while we had no opportunity to judge of the efficiency of the operation, it was physically a success and the handling of the tar was apparently much more simple than the use of the emulsion.

In the figures which I have prepared the tar is figured as dehydrated, but it was actually used with a considerable water content. I believe that the efficiency can be improved by dehydrating in the stills instead of in the generator.

It would seem to me that burning tar in the generator should be a simple thing for anyone who has reformed oil, as this is the manner in which we have handled it. Not having had much experience with reforming oil, a number of problems were encountered which would have not been new to one who was used to reforming. We made only minor changes in our operation, and to some extent those changes have been retained for regular operation without tar and without reforming. I have included some data on the cycle before and during tar operation. The principal change made was to decrease the blow run by two points on the automatic control, and add the same amount to the air purge. We also cut the back steam rate in order to compensate for the heat removed from the top of the fire by the tar. We had previously had occasional trouble with smoke at the beginning and end of the blow; and this was worse while burning tar than previously, so in connexion with burning of tar, we made some changes which should have been made anyway. We closed the carburettor blast valve two points ahead of the stack valve and opened it two points before the stack opens. In both instances there was only an insignificant puff of smoke.

We tried to open the generator blast and the carburettor blast at the same time with a resulting pop which lifted the stack valve and caused it to leak, so we advanced the generator blast to four points ahead of the stack. Our set is so arranged that the steam and generator blast are operated by the same cylinder on the automatic. As we had only six cylinders on our automatic, we had to add the blower intake valve to the same cylinder, in order to provide room for a tar control. The blower is electrically driven and runs continuously, and the closing of an Iris valve on the intake is the only control we have over the blower running idle. By means of a throttle valve and check valve we were able to delay action so that the Iris valve opened slightly before the generator blast and closed a fraction of a second after the generator blast closes. Were we to use a blower which stops during the run period, we would have to get an automatic with an additional cylinder. Making this change permitted us to use the blower piston to turn on and off the tar, which was handled exactly as the oil with the same spray, but a different set of oil valves and steam purge equipment.

Our first attempts were with hand control of valves which admitted tar to the oil spray during the back run, and included a hand operated steam purge. We endeavoured to distribute the tar injection pretty well over the length of the back run. We corrected the back run steam in accordance with the formula for reforming oil; that is, we decreased the steam about one-half as much as the weight of the tar injected. We found that this was not enough, and we had to decrease the steam about 100% for the water content, and something over 50% for the weight of the tar. We still had smoke, so we tried injecting the tar as fast as the oil spray would take it. We found that this required about ten points, or twenty-four seconds, leaving fifteen points of backrun, five points of steam purge, and two points of air purge to drive the smoke out of the machine before the stack was opened. We then had no further trouble with smoke. I think we have accomplished two things in speeding up tar injection. We sprayed the tar in at much better efficiency and also gave the machine an opportunity to clear itself before opening the stack.

BURNING TAR IN THE WATER GAS GENERATOR—LONG BRANCH, N.J.

Setting	Old Cycle	Cycle on Tar
Reverse Valves	92/67	91/65
Oil Valves	66/36	64/34
Stack Valve	0/30	0/30
Blower	36/96	
Tar Valve		76/66
Generator Blast	35/98	33/96
Carburettor Blast	29/0	28/98
Back Steam Rate	240	190
Stack Valve Opens	0	0
Carburettor Blast on	0	
Carburettor Blast Closes	29	28
Stack Valve Closes	30	30
Generator Blast Off	35	33
Oil On Up Run	35	34
Oil Off	66	64
Reverse to Back Run	68	65
Tar on Back Run		66
Tar Off		76
Reverse to Up Run	92	91
Generator Blast On	98	96
Carburettor Blast On		98

Division of Cycle	Old Cycle	Cycle on Tar
% Blast	30	30
Blow Run	5	3
Up Run	32	32
Back Run	25	26
Steam Purge	6	5
Air Purge	2	4

JERSEY CENTRAL POWER & LIGHT COMPANY: LONG BRANCH RESULTS DURING YEAR 1940. THE FIRST THREE COLUMNS COVER PERIODS USING EMULSION IN THE GENERATOR AND THE LAST THREE COLUMNS COVER THE FIRST SEVEN MONTHS OF THE YEAR WHEN NO EMULSION WAS USED.

	Total	Units	Cost	Total	Units	Cost
Gas made	124,514			833,450		
Set hours	596.9	208.6		3856.0	216.1	
Hours cleaning	78.1			377.5		
Running hours	518.8	214.0		3478.5	239.6	
Number of runs	7027	17.72		5191.7	16.05	
Average B.Th.U.	530.4			532.3		
Oil	445,077	3.57	13.180c.	3,126,597	3.75	13.845c.
Bituminous	339,440	2.73	0.801	1,888,575	2.27	0.666
Coke	1,886,092	15.15	6.477	12,853,390	15.42	6.592
Tar	24,263	0.195	0.585			
Total			21.043			21.103c.
Credit for steam saving in set (3¢/1,000 cu.ft.)			0.090			
Credit for dehydration saving			0.058			
Net cost			20.895c.			21.103c.
Cost of materials without tar	21.103c. per 1,000 cu.ft.					
Cost of other materials using tar	20.310	"	"			
Gallons of tar used	0.195	"	"			
Value per gallon	4.06c.					

* Presented at a meeting of the New England Gas Association, Operating Division, Jan. 15.

I have figured the economy obtained in our experiments in two ways. First, I added the cost of the tar to the cost of the other materials used in gas making, using a value of 3c. per gallon, which was the figure obtained from the sale of the tar and approximately the value obtained in the boilers. This method shows a cost for materials of 20.895c. During the preceding seven months when we had operated without tar our costs were 21.103c. This shows a saving of a little over .2c. per 1,000 cu.ft. Second, I took the difference in the cost of the materials less tar in the two operations and divided by the tar used. This computation resulted in a value of 4.06c. per gallon.

The results obtained so far are probably not the ultimate economy that can be obtained in burning tar in the generator. As in every other scheme for operating a water gas set, it is necessary to get a proper balance between the heat available and the heat required in the different parts of the set. The injection of tar into the top of the generator disturbs the existing balance. We tried to compensate by cutting down on the back-run steam. I am not sure that this is the way it should have been done. Maybe a change in the ratio of oil in the generator and carburettor might have served better. Further experimentation should be made before any final conclusions are drawn. What we have to report now is only the beginning. What has been accomplished has been done with makeshift equipment. We used the same spray for oil and tar. We found the spray which was intended for the oil would clog up rapidly with the tar and required frequent shut downs for cleaning. We purchased a blank spray and drilled it with five holes of equivalent capacity to the twenty holes in the original oil spray. We changed the angle from 30° with the vertical to 25° with the vertical. As you may surmise this was not one operation, but was a result of about a month of experimentation with different numbers and sizes of holes and different jet angles. If we assume that the original oil spray was most economical for oil alone, there must have been a decrease in oil efficiency reflected in the costs for operation with tar. We might be able to use the original oil spray with dehydrated filtered tar. Probably for best operations it will be necessary to have two sprays, one suited to oil and one suited to tar. On account of the large water content, we could heat our tar only to 200°. In burning it in the boilers, we obtain the best efficiency at 350°. With the makeshift pump which we used in our work, we were unable to obtain as high pressure for the low temperature as we used in the boiler room for the tar at the higher temperature.

We plan to make a further expenditure for equipment to use tar, but I do not yet know what should be specified. From the work so far, I am certain that there will be no difficulty in using in the water gas generator all of the tar that is left over after the boilers have been taken care of. There is, therefore, nothing to worry about if we are unable to dispose of our tar to outside contractors. With the lower values of water content, we handled tar to the equivalent of 10% of the oil used. A volume for volume allowance for the water in the tar would increase this ratio to about 14%. We may be able to use all the tar in the generator and buy cheaper fuel for steam making.

Our yield of tar is about ¾ gallons per 1,000 cu.ft., and if we can change the value of this entire amount from 3c. to 5¼c. the prospective savings would be 1.69c. per 1,000 cu.ft.

"Sinuflo" Boilers

"Sinuflo" Economic Boilers to work with natural and medium draughts are the subject of a new catalogue (No. 66) issued by Cochran & Co. (Annan), Ltd., 54, Victoria Street, S.W. 1. Neither of these new types is intended to replace the Cochran vertical boiler, but there are instances where that type of boiler may not be regarded as the most suitable for the site and other circumstances, and it is to meet such cases that the new boilers are offered. The natural draught 'Sinuflo" Economic may be chosen for cases where economical steam production under natural draught conditions is required. The medium draught boiler is intended for use where the induced draught high duty type is not required, and where a suitable chimney for natural draught is not practicable or permissible. It avoids the prohibitions and restrictions of local by-laws. Both boilers conform to the principles of the induced draught type as regards internal accessibility, ample breathing spaces between furnaces, tubes and shell, wide spacing of tubes, and large combustion chamber. Having more draught available than under natural draught conditions, the medium draught boiler is fitted with smaller and fewer tubes. Although the velocity of the gases through the tubes is higher than it would be in the natural draught type, the high heat transmission efficiency of the "Sinuflo" tubes gives a higher boiler efficiency than could be obtained with a boiler of the same dimensions fitted with straight tubes. The company has also issued a new leaflet (No. 57F) dealing with the "Sinuflo" induced draught Economic boiler for high duties.

The Cowan Gas Producer

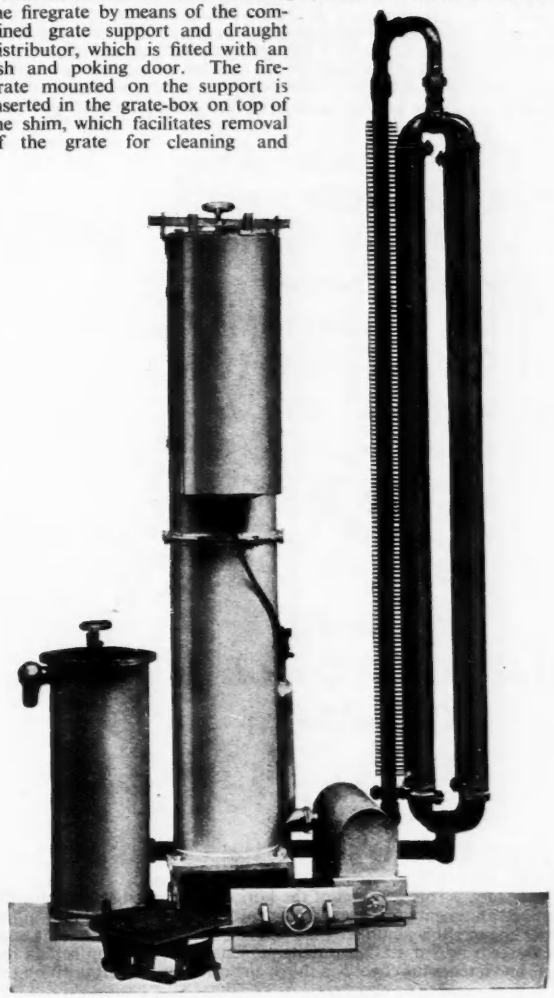
We had the opportunity last week of inspecting at work gas producers of an economical type manufactured by Messrs. W. & B. Cowan and known as the Cowan producers. This form of producer plant provides a ready means of obtaining an auxiliary gas supply which can be operated with a minimum of attention, using unskilled labour. The gas supplied is cool and clean, and its nature is such that it is readily burned with the minimum of adjustment on most types of burner. Furnaces, ovens, boiling pans and vats, callenders and presses, are among the many types of plant which can be heated efficiently by this method.

Cowan producers, it was explained to us, are installed on the unit principle, which provides a very flexible arrangement, as any number of units of a battery may be run to cope with the immediate demand, and the units left out of commission may be cleaned and charged ready for operation without interfering with the rest of the plant. Cleaning and charging a unit can be accomplished in a few minutes, and starting up takes only three or four minutes.

Output and Consumption

The output of a single Mark 2.C. Cowan Producer is 2 therms per hour (approximately 1,400 cu.ft. of 140 C.V. gas per hour), and at this rate a little under 20 lb. of low-temperature coke is consumed per hour. The recommended brand of fuel is Motor Coalite, but Progasite brand of anthracite may also be used. Other suitable fuels may be available in certain localities—some special gas-works cokes are suitable—and the manufacturers of the plant informed us that they would be pleased to report on any fuels which it is proposed to use.

A unit may be supplied as a mobile plant mounted complete on a trolley. The producer itself consists of the grate box immediately under the brick-lined fire zone; the upper part of the cylinder provides storage space for fuel which feeds by gravity as it is consumed. The gas is collected to the outlet by means of a special annular ring, which is situated within the cylinder immediately above the fire zone. The hot gas passes through the outer chamber of the heat exchanger, which preheats the primary air feed and vaporizes the water supplied from a tank via the atomizer. The steam and air mixture enters the grate box at the bottom of the heat exchanger, and is distributed evenly over the firegrate by means of the combined grate support and draught distributor, which is fitted with an ash and poking door. The firegrate mounted on the support is inserted in the grate-box on top of the shim, which facilitates removal of the grate for cleaning and



declinkering. The grate box is closed by means of a firedoor and the fuel hopper by means of a lid, both of which are secured by strongbacks. The gas outlet from the heat exchanger passes into the dustbox, which is cleaned periodically through the lid. The gas next passes through the cooler and to the filter containing at the bottom a tray of coke on which is placed a second tray. A pad of sisal is then inserted between the two trays. The filter is closed by means of a lid and during cleaning may be flushed through with water, which can be drained *via* cock. The gas is drawn from the filter outlet by means of an electrically or shaft-driven exhauster fan, the draught being controlled by a gate valve. The gas is then fed under pressure into the main.

An important feature of the Cowan gas producer is the high hydrogen content of the gas. This is over 11% and enables the gas to be burnt on free flame burners with practically no alteration. This means that when changing over from town gas to producer gas, the operation is much quicker and easier to accomplish than where producer gas is used which has a low hydrogen content. The water injector or atomizer which controls the amount of hydrogen present in the gas is of a special patented design, and is so constructed that it automatically proportions the amount of water passing into the pre-heater so as to allow the producer to supply the correct amount under varying loads. Another feature is that the plant can be operated without skilled attention, and, for that matter, will run for many hours without any attention at all.

We were impressed with the ease and rapidity of starting the producer on gas-making and also with its ready response to fluctuations of load. Several types of burner were in use at the time of our inspection, and the stability of the flames was marked. In present circumstances there is need for this type of plant, and Messrs. Cowan have to our mind prepared for this need very well indeed.

The foregoing description has been specially directed to the producer having a capacity of 2–2½ therms an hour. We also saw in operation a model of similar construction having a capacity of 5 therms an hour. Both patterns, we feel sure, are likely to find a wide field of application. Test figures carried out by an independent laboratory show a thermal efficiency of approximately 80%. The sulphur content of the unpurified gas is about 50 grains per 100 cu.ft. This is present largely as H_2S, which, of course, can be removed by oxide purifier if this is considered necessary.

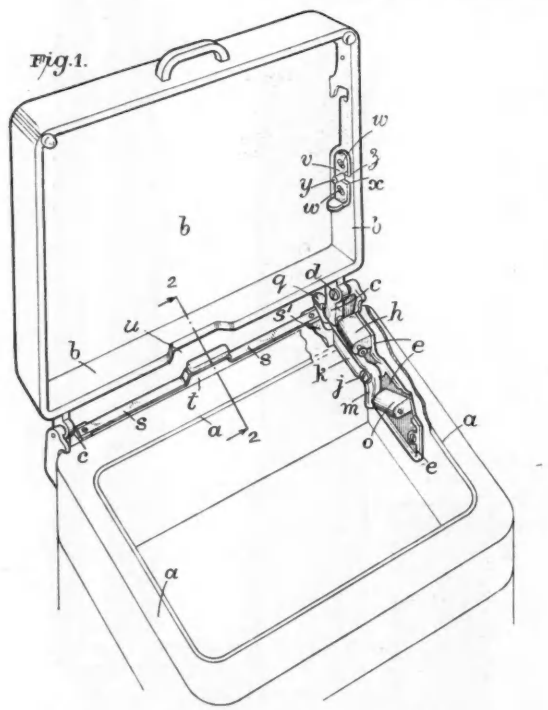
PATENTS

Cooker Lids

Hinged cooker lids form the subject of a patent (No. 532,974; application date, Sept. 19, 1939) granted to Cannon Iron Foundries, Ltd., and L. S. Porter.

Fig. 1 is a perspective view of a cooker top with the bars of the hotplate removed and the surrounding frame broken away to show the cover hinging and catching means. *a* is the surrounding cooker top frame or hot-plate frame and *b* is the hinged cover. The lid or cover *b* has on its rear edge at or adjacent to each side a stout lug *c* which receives a pivot pin *d* by which the cover is hinged to an attachment plate *e* secured by screws, or in any other convenient manner, to the side of the hotplate frame *a*. Each lug *c* extends beyond the pivot pin *d* for a substantial length, and when the cover is swung up into the vertical or open position the lug engages a spring-loaded plunger which is arranged in a housing *h* on the attachment plate *e* and resists the last part of the opening movement of the cover. A bell-crank lever pivotally mounted on the attachment plate at *j* has a substantially horizontal, rearwardly extending arm *k* and a downwardly and forwardly extending arm *m* which is engaged by a spring-loaded plunger arranged in the housing *o* on the same attachment plate *e*, the spring plunger urging the rear end of the horizontal arm

Fig. 1.



k upwardly. This rear end of the horizontal arm *k* has an upwardly cranked abutment part *q*, and as the cover *b* is opened the lug *c* on the cover engages this abutment part and rides over and depresses it until the cover is fully open, when the abutment part swings up behind the lug *c* and latches the cover *b* in the open position. In this position the lugs *c* are forced against the abutments *q* by the spring-loaded plungers so that the cover is tightly held and is free from rattle. Each abutment part may be provided with an adjustable stud or tappet which engages the lug *c* on the cover so that the open position of the cover can be accurately adjusted.

The rearwardly extending arms *k* of the two bell crank levers are connected by a transverse bar *s* which is stepped up in the middle as at *t* in alignment with a cut-away portion *u* of the rear edge of the cover so that the bar can be readily depressed by the fingers to release the cover, the cover first being pressed back against the action of the spring-loaded plungers to relieve the pressure on the levers. The abutment parts of the levers may, if desired, be slightly undercut to engage with complementary inclined parts of the lugs so that there is no risk of the cover being accidentally released.

The bar *s* is shown attached to the catches by screwing its ends down on to the cranked upper ends of brackets s^1 screwed to the sides of the lever catches.

Where the cover is fitted with a folding plate rack which is hinged to the cover and swings down into the cover before the cover is lowered, a gravity catch is preferably provided to retain the rack in the folded position and prevent it from swinging out as the cover is lowered.

This catch conveniently consists of a plate *v* of substantial weight slidably connected to one side of the cover by screws or studs passing through inclined slots *w* in the plate. The plate has a notch *x* in its front edge to receive a pin *y* on the plate rack when the rack is folded, the entrance to the notch having an inclined nose *z* so that as the rack is folded the pin raises the plate which then drops down to retain the pin in the notch. The inclined movement of the plate ensures that it retains its position relative to the cover whether the cover is in the vertical or horizontal position. The folding plate rack may follow on known lines and is not illustrated.

If the pivots or hinge pins *d* by which the cover *b* is hinged to the attachment plate *e* are made with a plain part in the lid lug *c* and a shouldered down and screw-threaded part entering the plate *e*, the lid or cover can be readily attached to and detached from the plate.

The springs of the plungers are fairly strong and hold the cover lugs *c* resiliently but firmly against the abutment ends *q* of the lever catches in the open position of the cover.

Variable Resistances

A patent (No. 533,038; application date, Aug. 9, 1939) granted to the Gas Light & Coke Company and R. P. Donnelly relates to apparatus for the measurement and indicating or recording of pressure difference. The invention is concerned with apparatus in which the movement of a liquid column in a manometer, due to a change of pressure, gives rise to a change in electrical resistance in a circuit, so that the change can be utilized to indicate or record electrically the pressure difference set up.

Suggestions have already been made to utilize in apparatus for measuring pressures and kindred purposes the conductive properties of mercury so as to increase or decrease the resistance of a member in contact with the mercury as the mercury rises or falls, either by inserting the member in the mercury in a mercury column manometer tube, or by employing a float in a passage through which gas, vapour, or liquid flows and directly connected to one or more resistance rods dipping into mercury. Mercury column manometer apparatus can be used, of course, for measuring or indicating pressure differences, but owing to the density of mercury, the change in level for a given change in pressure difference is relatively small. There is, in fact, no liquid (apart from electrolytes) which is relatively light and at the same time is sufficiently conductive to be suitable for making direct contact with a variable electrical resistance. The object of the invention is to devise a form of pressure measuring apparatus which utilizes the property of mercury as a conductor and facility in varying electrical resistance due to relative movement between a resistance and the

(*Patents continued on p. 522*)

Gas Products Prices

The London Market

Mar. 17.

The prices of Tar Products in the London Market are to-day as indicated below: Pitch nominal; creosote 4¾d. to 5d. per gallon; refined tar 3¾d. to 4d.; pure toluene under the Ministry of Supply Toluene No. 2 Order is 2s. 5d.; pure benzole is 1s. 10d.; 95/160 solvent naphtha 2s. 3d.; and 90/160 pyridine about 15s.; all per gallon naked; refined crystal naphthalene £23 per ton in bags; all *ex* Makers' works.

The Provinces

Mar. 17.

The average prices of gas-works products during the week were: Pitch and Crude Tar,* Toluole, naked, North, 1s. 10d. (controlled by the Control of Toluene No. 2 Order, July 5, which fixes the maximum price at which this material may be sold). Coal tar, crude naphtha, in bulk, North 9½d. to 10d. Solvent naphtha, naked, North, 1s. 9d. to 1s. 10d Heavy naphtha, North, 1s. 5d. to 1s. 6d. Creosote, *ex* works, in bulk, North liquid and salty, 4½d. to 4¾d.; Scotland, 4½d. to 4¾d.; low gravity, 4½d. to 4¾d. Fuel Grade 4d. to 4¼d. Carbolic acid, 60's, 3s. 9d. to 3s. 10½d. Naphthalene, £15 to £20. Salts, 75s. to 85s., bags included. Anthracene, "A" quality, 4½d. to 4¾d. per minimum 40% purely nominal. Heavy oil: Unfiltered anthracene oil (min. gr. 1,080), 5¼d. to 5½d.; filtered heavy oil (min. gr. 1,080), 5¾d. to 6d.; heavy anthracene oil gr. less than 1,080, 6d. to 6¼d.

* In regard to pitch and crude tar prices we would ask readers to refer to the editorial note in our issue of Sept. 4, 1940, p. 404.

Tar Products in Scotland

GLASGOW, March 15.

No material alteration in market conditions can be reported. A steady throughput is being maintained.

Refined tar remains steady in the home market at 4½d. to 4¾d. per gallon, while for export supplies can be obtained at 3¼d. to 3½d. per gallon both f.o.r. naked.

Creosote oil is still in good demand at the following prices: Specification oil, 5d. to 5¼d. per gallon; low gravity, 6d. to 6½d. per gallon; neutral oil, 5¾d. to 6d. per gallon; all *ex* Works in bulk.

Cresylic acid is still rather quiet, but makers are maintaining quotations as follows: Pale, 99/100%, 2s. to 2s. 2d. per gallon; Pale, 97/99%, 1s. 9d. to 1s. 10d. per gallon; Dark, 97/99%, 1s. 6d. to 1s. 7d. per gallon; all *ex* Works in buyers' packages.

Crude naphtha is only available in small quantities at round 6½d. to 7½d. per gallon *ex* Works in bulk, according to quality.

Solvent naphtha is maintained at 1s. 8½d. to 1s. 9d. per gallon for 90/160 grade and 1s. 4½d. to 1s. 5½d. per gallon for 90/190 Heavy Naphtha.

Pyridines continue weak at about 15s. per gallon for 90/160 grade and 17s. per gallon for 90/140 grade.

THIS WEEK'S ADVERTISERS

	PAGE
A.C.E. Machinery, Ltd.	496
Alder & Mackay, Ltd.	523
Ascot Gas Water Heaters, Ltd.	Cover I
Ashmore, Benson, Pease & Co., Ltd.	496
Bale & Church, Ltd.	525
Blakeley, Firth, Sons, & Co., Ltd.	525
British Aero Components, Ltd.	493
Brotherhood, Peter, Ltd.	501
Clayton, Son, & Co., Ltd.	Cover IV
Cowan, W. & B.	Cover III
Dempster, R. & J., Ltd.	489
Dempster, Robert, & Sons, Ltd.	512, 525
Donkin Co., Ltd. (The Bryan)	Cover II
Drakes, Ltd.	497
Durasteel Roofs, Ltd.	525
Ellison Insulations, Ltd.	525
Gas Meter Co., Ltd.	Cover IV
Gas Purification and Chemical Co., Ltd.	525
Glover, Thos., & Co., Ltd.	502
Griffiths Bros., & Co. (London), Ltd.	515
Harris & Pearson, Ltd.	Cover IV
Harrisons (London), Ltd.	526
Harvey, G. A., & Co. (London), Ltd.	491
Holmes, W. C., & Co., Ltd.	527
Horden Collieries, Ltd.	523
Humphreys & Glasgow, Ltd.	500
Hyde, Silas, Ltd.	492
Incandescent Heat Co., Ltd.	499
Keith Blackman, Ltd.	528
King, Walter, Ltd.	525
Londex, Ltd.	525
London Electric Firm	523
Main, R. & A., Ltd.	518
Mewburn Ellis & Co.	525
Parkinson, W., & Co.	502
Pass, E., & Co.	494
Peebles & Co., Ltd.	492
Pegson, Ltd.	Cover II
Radiation, Ltd.	516, 517
Reavell & Co., Ltd.	524
Slingsby, Walter, & Co., Ltd.	523
South Hetton Coal Co., Ltd.	524
South Metropolitan Gas Company	519
Spencer (Melksham), Ltd.	494
Stewarts & Lloyds, Ltd.	495
Strachan & Henshaw, Ltd.	525
Sutherland Meter Co., Ltd.	490
Technological Institute of Great Britain	525
Trotter, Haines & Corbett, Ltd.	525
Turbine Furnace Co., Ltd.	498
Universal Asbestos Manufacturing Co., Ltd.	524
Visco Engineering Co., Ltd.	528
Walker, C. & W., Ltd.	498
Walker, Crosweller & Co., Ltd.	499
West's Gas Improvement Co., Ltd.	520
Woodall-Duckham Co., Ltd.	511
Wright, Alex., & Co., Ltd.	491
Appointments Vacant	526
Educational	525
Contracts Open	526
Patents	525
Plant, &c.	525
Plants, &c., For Sale and Wanted	526

A.R.P.

PROTECTION OF SANDBAGS.

METRO CREOSOTE EMULSION

METRO COPPER CREOSOTE EMULSION

Both Emulsions conform to the Specification of the Ministry of Home Security Memorandum A.R.P. 279/1939 — 20/10/39, and are available in GREEN at slight additional cost.

SOUTH METROPOLITAN GAS CO.

Products Department:

REGIS HOUSE, KING WILLIAM STREET, E.C.4.

Telephone : AVENUE 2755.

For every size of works and every class of coal...

WEST'S

CARBONIZING PLANTS

GLOVER-WEST VERTICALS

WESTVERTICAL CHAMBERS

440 carbonizing plants have been built or are under construction by West's in 24 countries. Working results from a wide variety of gas coals have established the high efficiency and adaptability of the West systems.

WEST'S

GAS IMPROVEMENT CO · LTD ·

MILES PLATTING MANCHESTER 10

TELEPHONE—COLLYHURST 2961-2-3-4-5 · TELEGRAMS—STOKER, MANCHESTER

LONDON OFFICE TEMPORARY ADDRESS—BATH ROAD · HARMONDSWORTH · WEST DRAYTON · MIDDLESEX TEL.—WEST DRAYTON 2288-9

GAS STOCKS AND SHARES

The chief feature of Stock Exchange business last week was the strength of British Funds, and at the close 3½% War Loan reached 104 3/16, thus passing the 1938 peak of 104—2½% Consols which went *ex* div. on March 3 finished the week at 77¼. On the other hand home rails were quiet and dull. There was no improvement in the turnover among industrials, which generally were inclined to weaken. With the exception of Eagle issues the previous activity in oil shares was not maintained. Rubber and tea shares showed little change and continued dull and neglected.

There was a fair volume of business in the Gas Market and prices on the whole remained steadier than a week ago. The majority of price movements were on account of *ex* div. markings, and apart from these the only changes of note in the Official List were those of South Metropolitan 6% preference, which weakened 5 points to 80, while the reduced dividend announcement led to a similar fall in British ordinary. On the other hand Croydon 5% debenture rose 5 points to 97½. On the Provincial Exchanges it will be seen that Newcastle units advanced 6d. on support to 17s. 6d., but nominal quotations in the Supplementary List, apart from *ex* div., remained unchanged.

Among the latest dividend announcements appears that of the Alliance and Dublin Company, which is distributing 3% for the half-year to December last, against 3½% for the corresponding period a year ago, while the Directors of the British Gas Light Company are recommending a final dividend of 3%, making 6% for the year 1940, as compared with 7½% for 1939. The net profit in this case has been returned at £126,822, against £102,866 for the previous year.

Quotations on the London and Provincial Stock Exchanges

OFFICIAL LIST

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations March 6.	Rise or Fall on week.
1,767,439	Sept. 16	7	7	Alliance & Dublin Ord. ...	103—108	...
374,000	Dec. 30	4	4	Do. 4 p.c. Deb.	90—95	...
957,608	Nov. 4	5	5	Ascd. Gas & Water U'd'ts Ord.	11/6—13/6	...
500,000	"	4½	4½	Do. 4½ p.c. Red. Cum. Pref.	14/6—16/6	...
535,545	"	4	4	Do. 4 p.c. Red. Cum. Pref.	14/6—16/6	...
336,646	"	4	4	Do. 4 p.c. Irred. Cum. Pref.	10/—13/-	...
561,370	Feb. 17	7	7	Barnet Ord. 7 p.c.	95—100	...
300,000	Oct. 14	1/9 3/8	1/4 5/8	Bombay, Ltd.	19/6—21/6	...
490,407	Feb. 24	7	7	Bournemouth 7 p.c. max. ...	102—112	...
362,025	Dec. 16	4	4	Do. 4 p.c. Deb. ...	87—92	...
659,955	March 3	4 3/8	2½	Brighton, &c., 5 p.c. Con. ...	58—68*	—2
855,000	Sept 30	8	6	Brit. Gas Light Ord.	70—80	—5
545,000	Dec. 16	5½	5½	Do. 5½ p.c. 'B' Cum. Pref	105—115	...
120,000	"	4	4	Do. 4 p.c. Red. Deb.	75—80	...
10,000	Nov. 6 '33	6	4	Cape Town, Ltd., 4½ p.c. Cu. Pf.	¼—¾	...
626,860	Feb. 3	6	6	Cardiff Con. Ord.	87—92	...
24,500	Sept. 23	7	7	Colombo 7 p.c. Pref. ...	19/—21/-	...
764,169	Oct. 7	-/11.48	-/11.48	Colonial Gas Assn. Ltd. Ord. ...	14/—16/-	...
400,000	"	1/3.30	1/3.30	Do. 8 p.c. Pref. ...	19/—21/-	...
1,748,935	July 22	2	3	Commercial Ord.	28—38	...
620,000	Dec. 9	3	3	Do. 3 p.c. Deb.	57—62	...
286,344	Feb. 17	5	5	Do. 5 p.c. Deb.	85—90	...
807,560	Feb. 24	6	6	Croydon sliding scale	80—85	...
644,590	"	5	5	Do. max. div.	75—85	...
620,385	Dec. 30	5	5	Do. 5 p.c. Perp. Deb. ...	95—100	+5
179,500	Feb. 10	5	5	East Surrey 'B,' 5 p.c. ...	60—70	...
176,461	Dec. 16	5	5	Do. 5 p.c. Deb. (Irred.)...	87—92	...
250,000	Nov. 11	4	6	Gas Consolidation Ord. 'B' ...	13/6—14/6	...
250,000	Nov. 11	4	4	Do. 4 p.c. Red. Cum. Pref.	15/—17/-	...
19,122,910	July 29	3 3/8	4½	Gas Light & Coke Ord. ...	10/6—11 6a	...
2,600,000	"	3½	3½	Do. 3½ p.c. max.	40—45	...
4,477,106	"	4	4	Do. 4 p.c. Con. Pref. ...	61—65	...
2,993,000	July 8	3¾	3¾	Do. 3¾ p.c. Red. Pref. ...	68—73	—2
8,602,497	Dec. 2	3	3	Do. 3 p.c. Con. Deb. ...	70—75	...
3,642,770	"	5	5	Do. 5 p.c. Red. Deb. ...	101—106	...
3,500,000	"	4½	4½	Do. 4½ p.c. Red. Deb. ...	99—104	...
700,000	Sept. 9	3½	3½	Do. 3½ Red. Deb. ...	80—85	...
5,600,000	May 13	4	8	Imperial Continental Cap. ...	42—47	...
43,820	Jan. 27	3½	3½	Do. 3½ p.c. Red. Deb. ...	75—80	...
231,978	Feb. 24	5	5	M.S. Utility 'C' Cons.	66—71	...
918,657	"	4	4	4 p.c. Cons. Pref.	70—75	...
675,000	Nov. 11	†4	†4	Montevideo, Ltd.	52—57	...
300,000	Nov. 18	7	9	Oriental, Ltd.	105—115	...
368,537	Dec. 9	8	6½	Plymouth & Stonehouse 5 p.c.	88—98	...
621,667	Feb. 3	7½	7½	Portsmouth & Gosport Cons.	90—95	...
648,999	Sept. 16	1/1	1/1½	Severn Val. Gas Cor. Ld. Ord.	13/—15/-	...
597,972	"	-/10 3/4	-/10 3/4	Do. 4½ p.c. Cum. Pref. ...	15/6—17/6	...
2,528,714	Sept. 2	1/-	-/7 3/8	South East'n Gas Cn. Ld. Ord.	7/—9/-	...
1,000,000	March 3	-/10 3/4	-/10 3/8	Do. 4½ p.c. Red. Cum. Pref.	13/6—15/6*	—/6
1,068,869	"	4	4	Do. 4 p.c. Irred. Cum. Pref.	10/—12/-*	—/6
6,709,895	Aug. 5	4	4	South Met. Ord.	38—43	...
1,135,812	"	6	6	Do. 6 p.c. Irred. Pref. ...	75—85	—5
850,000	"	4	4	Do. 4 p.c. Irred. Pref. ...	60—65	...
1,895,445	Dec. 30	3	3	Do. 3 p.c. Perp. Deb. ...	59—64	...
1,000,000	Jan. 15	5	5	Do. 5 p.c. Red. Deb. ...	98—103	...
1,543,795	Feb. 24	4	2	South Suburban Ord. 5 p.c. ...	55—65	...
512,825	"	5	5	Do. 5 p.c. Perp. Pref. ...	78—83	...
500,000	"	4	4	Do. 4 p.c. Perp. Pref. ...	60—65	...
250,000	"	3¾	3¾	Do. 3¾ p.c. Red. Pref. ...	78—83	...
888,587	Dec. 16	5	5	Do. 5 p.c. Perp. Deb. ...	93—98	...
750,541	Feb. 10	5	2	Southampton Ord.	50—60	...
350,000	Feb. 10	5½	5½	Swansea 5½ p.c. Red. Pref. ...	91—96	...
1,076,495	Feb. 24	5	5	Tottenham & District Ord. ...	65—70	...
338,555	"	5	5	Do. 5 p.c. Pref.	78—83	...
453,380	Dec. 9	4	4	Do. 4 p.c. Perp. Deb. ...	76—81	...
1,247,505	May 20	4	6	U. Kingdom Gas Cor. Ord. ...	13/—15/-	...
1,085,952	Nov. 25	4½	4½	Do. 4½ p.c. 1st Cum. Pref. ...	13/6—15/6	...
772,709	"	4	4	Do. 4 p.c. 1st Red. Cum.Pref.	13/—15/-	...
745,263	Dec. 16	4½	4½	Do. 4½ p.c. 2nd Non.Cum. Pf.	12/—14/-	...
1,200,000	Sept. 9	3½	3½	Do. 3½ p.c. Red. Deb. ...	85—90	...
380,606	Aug. 5	7	6 3/8	Uxbridge, &c., 5 p.c.	80—90	...
1,371,138	March 3	4	4	Wandsworth Consolidated ...	65—70*	+2½
2,525,768	"	4	4	Do. 4 p.c. Pref.	60—65*	...
1,343,964	Dec. 16	5	5	Do. 5 p.c. Deb.	92—97	...
383,745	"	4	4	Do. 4 p.c. Deb.	75—80	...
558,342	Feb. 24	5	5	Watford & St. Albans Ord. ...	82—87*	...
300,000	Dec. 9	3½	3½	Do. 3½ p.c. Red. Deb. ...	84—89	...

SUPPLEMENTARY LIST

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations March 6.	Rise or Fall on week
351,685	Dec. 16	5	5	Brighton, &c., 5 p.c. Perp. Deb.	88—93	...
28,700	" 17	5½	5½	Do. 5½ p.c. Red. Deb. 1942 ...	95—100	...
415,250	" 23	4	4	Bristol Gas Co., 4 p.c. New Deb.	83—88	...
140,205	Feb. 3	7	7	Cambridge, &c., 7 p.c. Cons. 'B'	100—110	...
295,932	March 3	5	5	Cheltenham, 5 p.c. Cons. Ord....	85—90*	—3
42,500	Dec. 16	4	4	Do. 4 p.c. Perp. Deb....	75—80	...
150,000	Feb. 24	4	4	Croydon Gas, 4 p.c. Pref. (Irr.)	65—75*	...
130,000	Dec. 30	4	4	Do. 4 p.c. Deb. ...	75—80	...
146,700	Feb. 10	5½	5½	East Surrey, 5½ p.c. Pref. 'A' ...	80—90	...
53,220	"	6	6	Do. 6 p.c. Cum. Pref. ...	90—100	...
...	Aug. 19	6	4	Eastbourne, 'B' 3½ p.c....	65—75	...
239,135	Nov. 11	5	5	Gas Consolidation 'A' Ord. (£1)	13/—15/-	...
156,600	Feb. 24	5	5	Hampton C't, 5 p.c. Cons. Ord.	67—72*	...
18,000	Dec. 2	7	7	Malta & Med'n., 7 p.c. 1st Pref.	50—60	...
10,845	" 2	7½	7½	Do. 7½ p.c. 2nd Pref.	50—60	...
50,000	Feb. 24	£5 19 6	£5 4 6	Mid. South. Util., 'A' Cons. 5 p.c.	60—70*	...
65,000	Aug. 12	5	5	North Middlesex, 5 p.c. Pref. ...	87—92	...
70,000	Sept. 9	5	5	Plymouth & Stone., 5 p.c. Deb.	87—92	...
76,501	Dec. 30	4	4	Reading, 4 p.c. Perp. Deb. ...	70—75	...
74,777	Sept. 30	4	4	Romford, 4 p.c. Debs. (Reg.) ...	77—82	...
21,000	Dec. 16	5	5	Slough, 5 p.c. Perp. Deb. ...	87—92	...
211,740	" 30	5	5	Southampton, 5 p.c. Red. Deb.	90—95	...
363,575	Dec. 30	5	5	Tottenham, 5 p.c. Reg. Red. Mt.	94—99	...
202,019	Oct. 14	6 3/8	6½	Tunbridge Wells, 4 p.c. Scale ...	67—72	...
135,257	June 10	5	5	Uxbridge &c., 5 p.c. Perp. Deb.	88—93	...

PROVINCIAL EXCHANGES

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations Feb. 28.	Rise or Fall on week
47,756	July 26	6	5	Bath Cons.	94—98	...
122,577	July 22	7	6	Blyth 5 p.c. Ord.	100—105	...
1,667,250	Feb. 24	5	5	Bristol, 5 p.c. max.	86—88*	—2
120,420	Dec. 16	4	4	Do. 1st 4 p.c. Deb.	92½—94½	...
415,250	"	4	4	Do. 2nd 4 p.c. Deb. ...	91—94	...
328,790	"	5	5	Do. 5 p.c. Deb.	107—110	...
157,150	Feb. 3	5	6½	Chester 5 p.c. Ord.	98—101	...
92,500	Dec. 16	4	4	Do. 4 p.c. Pref.	79—81	...
36,430	"	3½	3½	Do. 3½ p.c. Deb.	79—84	...
41,890	"	4	4	Do. 4 p.c. Red. Deb. ...	93—97	...
542,270	Feb. 10	6	9	Derby Cons.	98—103	...
55,000	Dec. 16	4	4	Do. 4 p.c. Deb.	75—80	...
10,000	Aug. 19	10	10	Great Grimsby 'A' Ord. ...	155—165	...
6,500	"	10	10	Do. 'B' Ord. ...	155—165	...
79,000	"	10	10	Do. 'C' Ord. ...	145—155	...
732,000	Feb. 24	4	4	Hartlepool G. & W. Cn. & New	61—63*	...
2,167,410	Feb. 17	6	6	Liverpool 5 p.c. Ord.	88¾—92½	...
245,500	Dec. 16	5	5	Do. 5 p.c. Red. Pref. ...	97½—100½	...
306,083	July 15	4	4	Do. 4 p.c. Deb.	98—100	...
20,000	Dec. 23	5	5	Long Eaton 5 p.c. Pref. ...	9—11	...
80,000	"	5	5	Do. 5 p.c. Deb.	87—92	...
2,430,267	Feb. 10	5	5½	Newcastle and Gateshead Con.	17/—18/-a	+-/6
682,856	"	4	4	Do. 4 p.c. Pref.	79—81	...
776,706	Dec. 23	3½	3½	Do. 3½ p.c. Deb.	80—85	...
277,285	Oct. 21	5	5	Do. 5 p.c. Deb. '43 ...	97—102	...
274,000	July 26	5	5	Newport (Mon.) Ord.	89—93	...
13,200	Sept. 16	8 3/7	7	Pontyp'l Gas & W. 10 p.c. 'A'	11½—12½	...
13,600	"	6	5	Do. 7 p.c. 'B'	9½—10½	...
40,000	"	5	6	Do. 7 p.c. 'C'	9½—10½	...
106,280	Feb. 3	10	10	Preston 'A' 10 p.c.	157—167	...
188,219	"	7	7	Do. 'B' 7 p.c.	113—122	...
1,806,339	Feb. 24	6½	6½	Sheffield Cons.	113—115	—1
95,000	Jan. 6	4	4	Do. 4 p.c. Deb.	96—98	...
332,351	Feb. 3	6	6	Sunderland 6 p.c. max. ...	107—112	...
140,778	Feb. 12	5	5	Weston-super-Mare Cons. ...	79—84	...
64,338	Dec. 30	4	4	Do. 4 p.c. Deb.	80—85	...
33,340	"	7½	7½	Do. 7½ p.c. Deb.	135—140	...

a.—The quotation is per £1 of Stock. * Ex. div. † Price free of income-tax.

PATENTS—continued.

mercury with which it is in contact, and at the same time, to provide a device which is relatively sensitive so that low pressure differences of any desired order may be easily measured or indicated.

The apparatus includes a manometer device in which the liquid, the column of which moves with change in the pressure differences, is different from mercury and preferably has a considerably lower density, and the movement of this liquid column is employed to cause relative movement between an electrical resistance member and a body of mercury in contact with that resistance, so that the relative movement, and therefore the relative continuous change in resistance, depends upon the change of level in the manometer liquid, and therefore upon its density, and does not depend in any way on the density of the mercury. The body of mercury may be stationary and the resistance member, which is relatively light, may be caused to become immersed more or less in the mercury in accordance with the change in level of the manometer liquid. On the other hand, the resistance element may be stationary and the body of mercury may be contained in a vessel which moves relatively to the resistance element by an amount depending upon the change of level of the manometer liquid. In either case, a float or system of floats may rise and fall with the manometer liquid and may directly raise and lower either the resistance element or the body of mercury. It is found convenient to use as the resistance element a carbon composition rod formed of carbon in the form of graphite, which is bonded with a refractory material which serves to support the graphite in the form of a rigid rod. By choice of the proportions of graphite and refractory material, a rod of any desired resistance may be obtained. In actual fact, the graphite core of a lead pencil forms an entirely satisfactory resistance element for this purpose.

The change in resistance may be indicated in an electrical circuit of any desired way, for example, by including a battery in the circuit with a direct measuring instrument which can be calibrated in terms of pressure difference, or the variable resistance may form one arm of a bridge, the variable and adjustable resistance of which then forms an indication of the pressure difference.

The novel apparatus may be used for a number of purposes, and the indicator may be situated at a point remote from the source of pressure. It may here be mentioned, however, that it is suitable for use for tabular compensation in gas calorimetry. In such a case, the compensation for variation in temperature and pressure under which the gas is metered, is usually obtained from the expansion or contraction of an enclosed volume of air which is subject to the atmospheric pressure under which the gas is metered, and which is maintained at the same temperature as the gas at the metering point. Such a volume of air expands when its temperature is increased, and also expands when the barometric pressure falls. This may be utilized in an apparatus according to the invention by causing such an adjusted volume of air to act on one column of the liquid manometer, and to allow the atmospheric pressure or the atmospheric pressure plus the pressure of the gas to act upon the other column. Then the change in resistance in the apparatus allows for the change of temperature of the gas and change of atmospheric pressure. The change in electrical resistance can then be used to make the appropriate correction in the recording of the calorific value of the combustible gas.

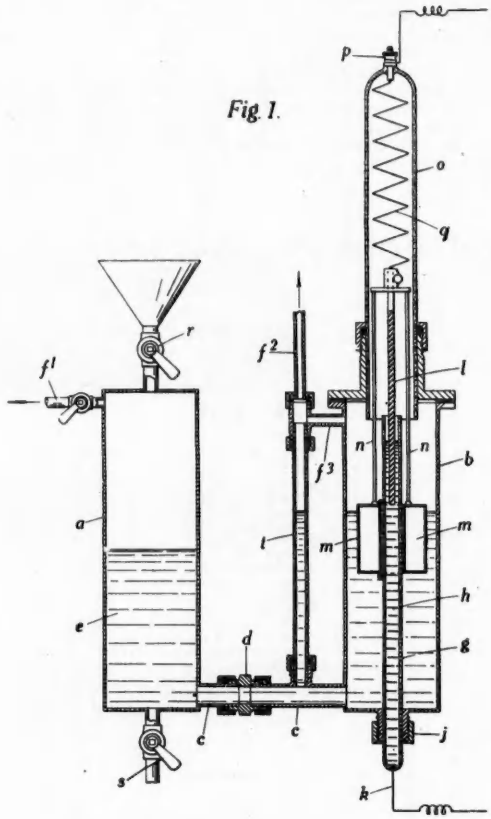
Fig. 1 is an elevation in section of one form of apparatus.

The apparatus consists of two metal cylinders, *a*, *b*, connected at their lower ends by the tubes *c* joined by the union *d*. The manometer liquid in these tubes, which form the equivalent of a **U**-tube, is shown at *e* and is preferably liquid of relatively low density, such as water, oil, or butyl phthalate. Each cylinder is provided with a pressure off-take f^1, f^2. A tube of non-conducting material *g*, filled with mercury *h*, passes through the cylinder *b* and is sealed in its base by a stuffing box *j*. It is provided with a terminal *k* at its lower end connected to the mercury *h*. The graphite composition rod is shown at *l*, partly dipping into the upper end of the mercury *h*. It is supported by an annular float *m* surrounding the tube *g* and connected to it by rods *n*. The top of the cylinder *b* is closed by a hood *o* preferably of transparent material and which bears a terminal *p* connected to the upper end of the graphite rod *l* by a flexible connexion or pigtail *q*. The **U**-tube system can be filled with the liquid through a filling funnel and cock *r*, and the liquid can be run off through a drain cock *s*.

When such an apparatus is used as a simple manometer, the higher pressure may be introduced through the outlet f^1 and the lower pressure, which may be atmospheric or other pressure, may be admitted through the outlet f^2, and is connected by the branch f^3 to the top of the cylinder *b*. The tube *t* is a glass tube and is provided as a visible gauge of the level of the liquid in the cylinder *b* when the cylinders *a* and *b* are of metal and are therefore opaque. The pressure difference depresses the liquid in the cylinder *a*, raising that in the cylinder *b* as shown, and carrying the floats *m* and the rod *l* up with it by an amount depending on the difference in pressure. The greater the difference in pressure, the greater the resistance of the rod *l*, as manifested at the terminals *k* and *p*.

It has been indicated that the graphite core of a lead pencil is suitable for use as the rod *l*. This may be 0.1 in. in diameter and 9 in. in length. It may contain about 72% of graphite, the remainder being refractory material, such as Fuller's earth. The rod, after baking, may be impregnated with wax or other suitable material to render it non-porous. Such a rod will have a resistance of about 50 ohms per inch length. Small variations in the percentage of graphite incorporated during manufacture cause considerable variation in resistance of the rods. Thus, a mixture containing 84% graphite has a specific resistance of about 15 ohms per c.c., while a mixture containing 72% graphite may have a resistance of about 390 ohms per c.c. The treatment in the manufacturing process—for example, the fineness of grinding and intimacy of mixing of the constituents—also has considerable influence on the specific resistance of the rod formed. All the rods of any one batch manufactured are found to be identical in resistance characteristics, and the apparatus can naturally be calibrated to suit the properties of a particular batch of rods.

Fig. 1.



When the apparatus shown in fig. 1 is to be used for tabular compensation in gas calorimetry, the liquid *e* employed may be water. The cock f^1 is open so that the pressure in the cylinder *a* is maintained at atmospheric pressure. The outlet f^2 communicates with a volume of air—the tabular volume—not shown in the drawing but which is otherwise totally enclosed. This tabular volume of air is maintained at the temperature of the gas as metered by a water-jacket or other suitable device; its pressure is necessarily maintained at that of the atmosphere, other than for small departures occasioned by the hydrostatic head generated between the two liquid levels in *a* and *b* by reason of the fact that atmospheric pressure is exerted by the cylinder *a* through the liquid into *b*. The liquid level in *b* then moves up or down in accordance with the contraction or expansion of the tabular volume under the combined influence of atmospheric pressure and gas temperature, causing movement of the float *m* and attached rod *l* to make the desired tabular compensation. The rod *l* and the mercury *h* are connected in the circuit of the recording unit of the calorimeter which includes, for example, a differential thermopile and a recording milli-voltmeter. The resistance of the thermopile, leads, and instrument, may be 90 ohms, the effective resistance of the graphite rod *l* under standard conditions of atmospheric pressure 30.0 in. of mercury, and at 50°F. is 10.0 ohms. The totally enclosed tabular volume of air under the same conditions is 3.0 litres. An alteration of conditions of temperature or atmospheric pressure, or of both combined, which gives rise to an increase of 10.0% of the volume enclosed in the cylinder *a*, gives a movement of the rod *l* of 3.37 in. and an alteration of resistance of 10 ohms.

A Correction

With reference to Patent No. 531091 for Pipe Joints, abstracted in the "JOURNAL" of March 5, there was an error in the wording of the specification.

The 9th line, p. 431, right-hand column, should read "is first fitted into the recess 13 of the socket"—not "of the spigot."